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Speech delivered by Rajamantra Pravina H. B. Gundappa Gowda, Esq., B.A., B.L., Minister for Local Self-Government and Public Health, at the 24th Annual General Meeting and Field-Day of the Mysore Agricultural and Experimental Union.

1944

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The Mysore Agricultural Journal

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Increasing Production of Manures: The Key to Food Self-Sufficiency in the State

By S. V. Govinda Rajan, B.Sc. (Hons.), Ph.D. (Lond.), D.I.C., A.I.C.
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The low productivity of Mysore soils, in common with the soils of the country, is chiefly due to their poverty of humus and combined nitrogen. The high average temperature of our climate causes rapid destruction through oxidation of the soil organic matter with the consequent loss of soil tilth and fertility. Adequate application of bulky organic manures, at least, annually are hence essential both to raise the level of soil productivity and maintain it.

At present the available supply of humus is obtained from limited amounts of indifferently prepared cattle manure or occasionally from green manure. Mysore has in all nearly one crore head of livestock of which about 48 lakhs are cattle. Making due allowance for the cattle that are kept near cities, towns and bigger villages, whose dung is generally converted into cakes and used as fuel, it may be estimated that about 35 lakhs of head of cattle kept in the smaller villages and on the farms may be available for the production of farmyard manure. It is doubtful if the ryots are making the best use of the solid and liquid excreta of the animals, but even supposing they do, the total amount of farmyard manure that may be available from the above source would amount only to about 70 lakhs tons a year, which if evenly distributed would serve at the rate of about one ton of manure per acre of land under cultivation. The satisfactory dosage of farmyard manure required, however, is much higher, being at least five times this rate.

As regards the quality of manure prepared and the method adopted in its preparation by the ryots, much leaves to be desired. Even after long periods of storage under dry conditions, as actually happens with little or no care bestowed on it, cattle manure is often only partially rotted, and large losses of carbon and nitrogen occur by wasteful bacterial decomposition. Cattle manure is largely applied only to garden lands and little is spared for rainfed staple crops. Green manuring does not fit in well with the rotation of normal rain grown crops, since when it is ploughed-in during the fallow, its decay by sowing time is very uncertain owing to irregularities of rainfall.

It is thus realised that the outstanding need is for a plentiful supply of cheap and readily available organic humified manure. Concerted efforts to prepare larger quantities of better quality manure out of the varied available organic waste products of the land and of the towns will need to be made to achieve this end. The measures to be undertaken in this drive will fall under the following heads:

(1) To increase the quantity of farmyard manure that could be made available for application to the land.

(2) To improve the quality of farmyard manure by better collection of the cattle excreta and improved methods of preparation and conservation of manure.

(3) To make a drive towards a larger and better utilisation of agricultural wastes by converting them into farm composts.

(4) To convert forest litter and leaf mould into compost for use as readily applicable manure for agricultural purposes.

(5) To prepare and make available humified manure by composting all varieties of town refuses, and lastly,

(6) Steps to be taken for the better utilisation of liquid waste materials of urban area in the form of sullage water or sewage which contains a large proportion of easily decomposable organic matter and manurially valuable mineral matter.

Detailed consideration can now be given to each one of the above means aimed at the better utilization of animal and plant waste materials by application to land as manure.

(1) Increasing Production of Farmyard Manure

Due partly to the lack of fuel material and partly to ignorance of its value, considerable quantities of cowdung are converted into cakes and burnt away as fuel. The soil in our country requires every bit of nitrogen and organic matter available; and to burn cowdung is to burn the fertility of the soil. From the 48 lakh head of cattle including young stock in the State, it can be estimated that about 90 lakh tons of cowdung will be produced per annum. Of this quantity at least a third, *i.e.*, about 30 lakh tons, will be lost to the land through wastage and use as fuel. The remaining quantity of about 60 to 70 lakh tons, if properly distributed, would serve only at a rate of about 1 ton per acre for the area under cultivation in the State. Efforts made to educate the ryots regarding the value of cowdung as a manure and to induce them to recover greater quantities for use as manure will prove quite fruitful. The present conditions of high price of fuel and in certain areas their scarcity will stand in the way of any marked success in propaganda on these lines. However, simultaneous efforts made to provide alternate sources of cheap fuel from village plantations, forests or otherwise will help to save the cowdung for the land.

(2) Improvement in the Quality of Farmyard Manure

The improvement of the quality of farmyard manure as is now commonly being prepared offers considerable scope for propaganda and enlightenment. Cattle urine contains about 1 per cent. of nitrogen in an easily mineralised and

available form and about 0.1 per cent. of phosphoric acid. On the average cattle void about 10 lbs. of urine per day and in the present-day methods the ryot takes very little regard to recovering and conserving this valuable constituent of animal waste product. If it were possible to collect even half of this quantity, *i.e.*, about 5 lbs. per day, together with the dung and litter refuse, the total plant nutrients recovered amount to very considerable quantities. For a 50 per cent. recovery of urine, the nitrogen saved works out to about 20 lbs. per head per year or for the total cattle population of the State, a total of about 45,000 tons of nitrogen per year. This amount of extra nitrogen represents a quantity which if properly applied to crops can cause extra grain production enough to offset the shortage in the State and make Mysore a surplus area.

The need, therefore, is to educate the ryot to recover at least half of the liquid excreta of his farm animals and by adding same to the cowdung to enrich the manurial value of the farm manure. An easily followed method of collection of cattle urine would be to absorb it in earth spread on the cattle yard and over the cattle bedding or else to soak up the liquid in small quantities of earth as it passes through the drains of the cattle shed. Or alternatively the collection of the drained urine into small reservoirs and their periodic transference to the manure pits and then covered up with thin layers of earth would be equally efficient methods.

Instruction to the ryots to prepare farm manure in trenches or on over-ground heaps carefully plastered over with earth will be an adjunct to the above-mentioned steps. Thin layers of earth spread over trenches or else plastered over heaps, help to preserve the manure from the wasteful effects of excessive aeration, heat and rainfall and retain better the manurial constituents.

(3) Preparation of Farm Composts from Agricultural Wastes

The conversion into compost of farm wastes which at present are not being turned into manure will form an important means of augmenting the quantity of manure now being prepared by the ryot only in the form of farmyard manure.

	Total approximate cultivated acreage in lakh acres	Inedible refuse available	
		Tons per acre	Total lakh tons
Food Crops—			
1. Cereals : Rice, Wheat ..	7·5	¼	1·5
2. Millets : Ragi, Jola, etc. ..	30·0	½	15·0
3. Pulses, including Horse-gram, Togari, Harka, etc. ..	14·0	½	7·0
4. Edible oil-seeds	6·0	½	3·0
5. Sugarcane	0·5	2½	1·3
6. Miscellaneous crops : Fodder crops, Plantains, Coffee, etc.	4·0	½	2·0
Non-Food Crops—			
1. Cotton	1·0	1	1·0
2. Inedible oil-seeds	1·0	1	1·0
3. Miscellaneous crops	1·0	1	1·0
	65·0	..	32·8

At present there is very little effort being made by the ryot to convert the inedible wastes from the crops into manure and considerable amounts of materials like cotton, togari and jola stalks are burnt away as fuel. Of course, certain quantities of waste materials like the stubble of ragi, paddy and other crops do get returned to the soil but as they are turned in an undecomposed or else only in a partly decomposed condition their manurial value will only be small.

It is estimated that at least 30 lakh tons of extra material can be made available as farm compost from the materials that are produced on the lands but which are improperly utilised at present. The following estimates give an idea of the possible quantities of inedible refuse that the ryot can be persuaded to conserve and convert into manure.

Efforts through propaganda should be made to educate the ryot to the value of the material available with him, which through ignorance or idleness he is at present not making proper use of.

(4) Conversion of Forest Litter into Compost

There are within the State over 19 lakhs of acres of forests and the variety of trees, plants and shrubbery of these forests periodically shed their leaves. The total quantity of vegetative matter thus collected on the ground aggregates to very considerable amounts, and these normally are not disturbed with a view to conserving the fertility of the forest lands. Authoritative opinion has recently been given by the Inspector-General of Forests that the removal of the fallen leaves for a comparatively short period, say three or four years out of a rotation of 120 years will not materially reduce the fertility of these lands. While no complete removal of the litter over the vast areas of the forest lands can easily be effected owing to the practical difficulties of labour and transport, the removal in limited quantities and at reasonably long intervals will seem quite possible and permissible.

The conversion of these forest litter and leaf mould into compost will to a considerable extent solve the problem of lack of farmyard manure, particularly in the Malnad districts where paddy is extensively cultivated. The forest areas in the three districts, Shimoga, Kadur and Mysore, together are over 60 per cent. of the total forest area of the State. While the cropped areas in these three districts come to a third of the total, the area under paddy is well over 60 per cent. of the State total and hence like the forest areas, is concentrated here. An abundant supply of good manure made available in these areas will without doubt result in the increased grain production from their cultivated lands. And the concentration of the forest areas also in these districts could reasonably be utilised to provide the much needed supply of cheap humified manure, at least for the duration of emergency.

The principle underlying the process involved is to convert leaf mould, recently fallen leaves, fresh green leaves, *tender twigs* and prunings, to a fermentation process so as to make the resulting product suitable as a manure fit for direct application to the field for growing food crops. This can be achieved either by stacking them in overground piles or in broad trenches, 3 to 3½ feet deep. To start the fermentation process of the fresh material, sprinkling with an adequate supply of water will normally appear to suffice, but a liberal application of an emulsion of fresh dung or an emulsion made from a previously fermented lot

of refuse will hasten the process when the litter material is too dry. The preparation of the compost in pits will help to conserve the moisture in the mass and to have a better control on the likely loss of ammonia by volatilization.

The cost of preparation of compost with the materials mentioned above is usually small. The figures given for the preparation at the Karnal Experimental Station (Punjab), is about Annas 8 to 10 per ton. The co-operation of the Forest Department would be essential for carrying out this work, and when this is secured it would appear possible to utilize considerable amounts of the forest leaf litter for conversion into compost and use as manure on the agricultural lands within easy reach of the forest areas.

(5) Compost from Town Refuses

The refuses of towns and villages like street sweepings, dustbin refuse, night soil, etc., consist of a high proportion of organic matter and their utilization for conversion into agriculturally useful manure has long attracted the attention of scientists in this country and abroad. The produce of the land which find their way to urban areas and reappear as town wastes represent a net loss to the land to the extent they do not get returned to the agricultural lands. Restoration of the materials taken out of the soil is but a proper means of maintaining its fertility. The present methods of disposal such as dumping to fill pits, incineration, etc., though sanitarily perfect and convenient, appear from the agricultural point of view highly wasteful, resulting as they do, in the loss not only of the organic matter, but of the major plant foods like nitrogen, phosphoric acid and potash that the plants had absorbed from the soil. Minor elements like boron, copper, manganese, zinc, etc., which play an obscure but a definite role in plant nutrition, do get absorbed in the plant material. and if they are not added to the soil in the form of composts or manure prepared with the plant wastes, little opportunity is afforded for their return to the soil in the usual type of fertilizers applied to the land.

"Composting" offers the best means of recovering the large quantities of refuse available in urban and other localities as manure of agricultural value and as this is a process involving biological fermentation of mixtures of animal and vegetable waste materials, it can be carried out conveniently anywhere without elaborate equipment. Chinese agriculturists have practised the art of composting for over forty centuries past, and it is to their assiduous return of human and agricultural wastes to their lands that the continued high fertility of their lands is attributed. Also this art is not new to the agriculturists of our own country, but it has been followed only in an empirical manner and to a very limited extent.

The researches of Hutchinson and Richards at Rothamsted, dating back to 1918, threw light on the scientific principles underlying the compost process and following on the development by them of the process known as "ADCO" for converting straw and such materials into compost by the addition of a patent mixture, other processes like the Beccari, Hyganic and 'Q.R.' methods were devised to convert urban and agricultural wastes into manures. Some of these methods involved the use of mechanical contrivances, which naturally restrict their widespread use and also put up the cost of the material finally obtained.

In our own country, the Indore process of Sir Albert Howard, the Activated Compost process of Dr. Gilbert Fowler and the Hot Fermentation process developed at Bangalore have successively been devised and advocated for effecting the conversion of refuse material into humified manure. Composting in these methods is dependent upon the addition in adequate quantities of nitrogenous material known as the 'starter', which may be either night-soil, sewage sludge, slaughterhouse waste, cattle dung and urine or inorganic nitrogenous substances like ammonium sulphate, calcium cyanamide, etc., to bulky organic refuse which may be either town refuse (street sweepings or mixed vegetable refuse of farms). Addition of a sufficient supply of water to keep the moisture content at about 50 per cent. and aeration of the mass by turnings provide satisfactory conditions for the rapid microbial breakdown of the complex mixed material. While most of the above methods have in view the preparation of manure in as short a time as possible by adjusting the initial carbon, nitrogen ratio by periodic turnings and addition of moisture, all of which mean labour and expense, the recent work at Bangalore by Dr. C. N. Acharya, carried out with a view upon the chemical and economic aspects of the processes shows that by carrying out the composting in fully packed trenches, the addition of water is minimised, turnings altogether avoided and thereby labour reduced appreciably. The period needed for complete decomposition is somewhat prolonged, being from about five to six months, but the quantity and quality of manure recovered are claimed to be higher than in the other methods. In view of the fact that over considerable areas of our State, the demand for manure comes only once in six months and in certain parts only once a year, the cheapness of the product obtained by this method, with its greater appeal to the ryot should weigh against the disadvantage of longer period needed for obtaining the mature manure.

The production of compost by these comparatively simple processes could be taken up by municipalities as a paying proposition, the demand for their product being firmly established through propaganda and the quality of material produced. By organising compost production in all the municipal centres of the State, it is estimated that over one lakh tons of compost could be prepared per year out of the collection of all the refuse material. Provided the larger panchayats and villages also take to conversion of the refuses available locally, the total quantity thus made available would be considerably greater.

(6) Utilization of Sewage Wastes

Sewage and sullage represent the water-borne portions of town refuse and consist of household washings, bath water, the discharges of human and animal waste products, etc. In towns provided with underground drainage systems, the sewage conveys all the solid excreta of the population, and hence is quite rich in organic matter and the usual manurial ingredients. The common method of disposal of such wastes is to lead into *nallas*, rivers or into the sea, convenient as it may seem from the view-point of sanitary disposal, results in the total loss of the manurial matter. Considerations of the utilization of such wastes could reasonably come with the types of waste materials discussed above.

The best method of utilizing these and other drainage waters from towns would be to use them to irrigate lands for raising crops. In a number of towns

in our country sewage farms exist where the sewage waters after passing either through septic tanks, or dilution with irrigation waters or in the raw stage are utilized for growing crops. The total number of such farms as are in existence are very few in number considering the number of urban centres in the country, and in the considered opinion of many, even these few leave plenty to be desired in the effectiveness and efficiency of use of the sewage available. Improvement in the working of the existing farms and the organization of sewage farms, big and small, all over the State offers considerable scope for future work. The usual manner in which these wastes can be used will be to use the raw sewage for either intermittent or broad irrigation of lands, particularly fodder crops, or after septic digestion in septic tanks, to use the effluent for irrigating a larger variety of crops including the market garden crops. Where there is sentimental objection or danger of contamination of greens and vegetables with raw sewage, the safest crops to grow will be grass and fodder crops.

Sewage sludge and septic tank scum, the bye-products of the septic tank, harbour a large and active microbial population and contain as high as 1.5 to 2.0 per cent. of nitrogen and 2.0 to 3.0 per cent. of P_2O_5 and hence possess a high manurial value. These could be applied either directly to land or used as "starter" for converting plant waste material into compost in situations where the high moisture content in their fresh state render transport to distant places rather difficult.

Conclusion

The fact emerges from what has been detailed above, that the efforts envisaged in a future drive would ultimately result in the production of extra manure to the extent of about 30 to 35 lakh tons, besides the compost that may be prepared out of the forest litter. This quantity does not appear very appreciable considering the needs of our soil and the goal set out to reach, and also in proportion to the large quantities of farmyard manure that are being produced even now. It might mean the addition of about half a ton of manure per acre extra on the average. Though the total quantity looks small, the important benefit to crops would be derived from improvement in the quality of the manure produced through the improved methods. A fifty per cent. collection of cattle urine by itself represents over 45,000 tons of *nitrogen* conserved all over the State, and in addition to this will be over 10,000 tons of *nitrogen* from the additional 30 lakh tons of extra manure assuming a nitrogen content of only 1 per cent. and an availability of 30 per cent.—truly colossal amounts, which if only put to proper use could easily overcome the present food shortage in the State.

Results of a Further Series of Experiments and Observations on the Control of Insect Pests of Food Grains in Storage

By B. Krishnamurti, B.Sc., F.R.E.S., and D. Seshagiri Rao, B.Sc.

The experiments and observations described in this paper form a continuation of those embodied in the authors' previous paper, and deal mainly with the effect on insects, of mixing certain substances (inert and insecticidal) in small quantities, with grains for short periods. Mainly weevils (*Calendra orizæ*) in rice and jola were selected for these experiments, since in the previous trials the effect of the different substances on this important pest had not been adequately tested; the reaction of two other beetles of somewhat secondary importance, occurring alongside the weevil, namely, *Tribolium* sp., and *Rhizopertha dominica* to different treatments, was also studied. (Trials involving larger quantities of grains in order to simulate conditions prevailing in bulk storage are also under way.) Naturally infested grain and insect-free grain with a definite number of weevils introduced either into it or just outside the receptacle (gunny bag) containing it, were both employed to determine the deterrent (and repellent) and insecticidal action of the various materials used in these experiments.

Small gunny bags cut suitably to hold the required quantity of grain and packed tight were mostly used in these experiments; in one series, culture dishes with cloth covers on them to facilitate free circulation of air were used. Each bag was enclosed in a glass jar with its mouth closed by a cloth cover except where the deterrent effect was sought to be studied when the bag was enclosed in a cage along with the control and a definite number of weevils released inside the cage. In the case of individual bags enclosed in glass jars, a definite number of weevils was put either inside the bag along with the grain or outside it in the jar. At the time of examination, in each case, a certain number of weevils was found outside the bag—some dead and others living, where weevils were put in the grain at first. The presence of the insects outside the bag and in the enclosing jar gave an indication of the *repellent* action of the substance; where weevils were introduced into the jar outside the bag, it gave a measure of its *deterrent* effect which was further tested in the cage trials. In the trials in which naturally infested jola was employed, dead weevils were removed preliminary to setting up the experiment in one series using paddy husk ash, and in other series, with a variety of substances they were not so removed. In the former series, the number of dead weevils collected from both outside and inside the bags was taken to be practically the actual total mortality due to the action of the materials. In the latter series the mortality at the time of examination was considered to be only the apparent and not the actual for the reason that the previously dead weevils are also included among the dead ones counted. The actual mortality in this series is really a figure arrived at by deducting the number dead initially from natural causes (assumed to be 69.1 per cent. of the total on the basis of the mortality in the control) and working out the percentage of mortality from this with reference to the number of live weevils counted at the time of examination.

To take an example:—

In Derris

Total number (alive and dead) at the time of examination ..	781 weevils
No. presumed dead from natural causes (69·1% of the total) ..	540 ,,
Therefore number presumed alive at the start	241 ,,
No. alive at the end	89 ,,
Percentage of mortality	63·0

In the case of other sets with insect-free jola, the actual mortality was arrived at as in the case of the lots of grain (infested) from which the initially dead insects were removed preliminary to setting up the experiments. Though these distinctions have been made for purposes of precise evaluation of the effect of treating grains in this manner, actually the insecticidal and deterrent (and repellent) properties are more or less on parallel lines in each case as may be gathered from a study of the tables. This is not surprising considering that a substance which is dangerous to the insect is naturally not attractive to it (except when it is suitably masked, etc.) and, therefore, the insect tries to run away from it. One possible proof of this is afforded by the fact that all the insects issued outside the bag are invariably coated with the substance mixed with the grain in each case; where it cannot escape from it, as in these experiments, it gets killed. The markedly small number of weevils penetrating into treated grains in contrast to the number entering the control where both are in the same cage is proof of the great deterrent effect of some materials.

The results of the several trials conducted confirm, generally, the conclusions drawn in the previous paper with reference to the materials experimented upon. To recapitulate briefly, road dust (fine) is useless and mercury has apparently no effect on adult weevils; wood ashes, lime powder and kaolin though effective to some extent, are not sufficiently so to warrant their use on a large scale. Derris and pyrethrum rank fairly high though the efficacy of the latter appears to depend on its age and mundulea needs further trial as the sample used was six years old. Paddy husk (coarse and fine) and its ash in the coarse form are of no value and may be eliminated. Copper carbonate, Coal ash (fine) and fine paddy husk ash have in all trials shown an exceptionally high rate of mortality which taken with the excellent deterrent qualities they have, stamp them as very efficient materials of practical importance; they would very probably also prove highly effective in the case of grains in bulk storage. Coal ash and paddy husk ash were ground to such a fine state as to make them pass easily through a 100-mesh sieve and the particles (measuring 4.5 to 13.5 microns in size) adhered readily to the grains.

The dried leaves of certain common plants reputed to have insecticidal property were also tested but do not appear to have any striking value. Further trials with these and such other materials are in progress.

In the experiments conducted with infested jola from which dead insects were not removed, rates of mortality of *Tribolium* sp., and *Rhizopertha dominica* were also studied. Since the populations of these species were much smaller than that of the weevil the figures given in the following table are only tentative and require confirmation by further tests. These species are probably tougher and more resistant than *Calendra* as may be inferred from the percentages of mortality given below but the action of the different substances on them is more or less parallel to their effect in *Calendra*.

TABLE I

The deterrent and insecticidal effect of certain substances mixed with insect-free grains

Receptacle	Grain its condition and quantity	Material mixed and its proportion	Percentage of Mortality	No. of weevils found		Remarks
				Outside the bag		
1. Gunny bags (enclosed in glass jars)	Rice (free from insects) 1 seer each. 100 weevils introduced outside each bag, in the jars	2% by weight of :				Examined after 12 days' exposure. The deterrent (and repellent) action of the substances may be judged by the percentage of weevils found outside the bags at the time of examination
		Derris	99·0	47		
		Pyrethrum	42·0	47		
		Mundulea	53·0	58		
		Road dust (Fine)	23·0	23		
		Wood ashes	36·0	36		
		Lime powder	74·0	73		
		Kaolin	54·0	54		
		(Control)	28·0	24		
2. Do.	Jola (free from insects) 1 seer each. 100 weevils introduced outside each bag, in the jars	Mercury (1·5 gms.)	23·0	17		
		1% by weight of :				
		Copper carbonate	100·0	91		
		Coal ash (Fine)	99·0	93		
		Paddy husk ash (Fine)	99·0	98		
		(Control)	23·0	25		
				Inside the bag	Outside the bag	
3. Gunny bags (enclosed in cage)	Jola (free from insects) 4 seers—treated, 1 seer —(control). 300 weevils introduced into cage	1% by weight of :				Examined after 3 days' exposure. 16 weevils found escaped. Repellent action of Paddy husk ash (Fine) treatment is indicated by the fact that only 8·4% of the number of weevils inside bags are found in the treated bag
		Paddy husk ash (Fine)	72·7	22	24	
		(Control)	0·8	238		

				Inside the bag	Outside the bag	
4. Gunny bags (enclosed in a jar)	Jola (free from insects) 1 seer each. 200 weevils introduced into jar	1% by weight of : Paddy husk ash (Fine)	71·4	7	26	Examined after 5 days' exposure. Repellent effect of treatment with Paddy husk ash shown by the fact that only 4% of the total number inside bags is found in the treated material
		(Control)	6·6	167		
5. Culture dishes (with cloth covers to facilitate free circulation of air)	Jola (free from insects) 10 oz. each. 100 weevils introduced into each	10% by weight of : Dried neem leaves (Powdered)	44·0	..	..	Examined after 3 days' exposure
		Dried vitex leaves (Powdered)	12·0	..	..	
		Dried patchoule leaves (Powdered)	24·0	..	..	
		(Control)	4·1	..	..	
6. Gunny bags (treated enclosed in cage and control bag in glass jar)	Jola (free from insects) 10 seers—treated (with 500 weevils introduced inside), 1 seer—(control) (with 100 weevils)	Paddy husk ash (Fine)	97·4	350 (62 weevils escaped)	88	Examined after 5 days' exposure. The 'control' was set up with a much smaller quantity of grain than the treated lot owing to lack of sufficient material
		(Control)	53·0	52	48	
7. Gunny bags (enclosed in cage)	Jola (free from insects) 10 seers– treated, 1 seer—(control). 600 weevils introduced into cage	1% by weight of : Paddy husk ash (Fine)	86·2	51	..	do. Of the 600 weevils introduced— No. missing .. 224 No. dead in petri dish 120 No. outside bags 75 (3 alive)
		(Control)	38·4	130	..	

TABLE II

The insecticidal effect of certain substances mixed with infested grains

Receptacle	Grain its condition and quantity	Material mixed and its proportion	Percentage of Mortality		No. of weevils found		Remarks
					Inside the bag	Outside the bag	
		A. With dead insects removed from grain					
1. Gunny bags (enclosed in glass jars)	Jola (heavily infested, dead weevils removed) one seer	1% by weight of :	Actual				
		Paddy husk ash (Fine)	80·0		73	276	Examined after 3 days' exposure. The repellent nature of Paddy husk ash (Fine) is shown by the greater number of weevils found outside the bag than in the case of the other two
		Paddy husk ash (Coarse)	29·5		164	80	
		(Control)	27·6		208	67	
		B. Dead insect not removed from grain					
2. Gunny bags (enclosed in cloth bags)	Jola (heavily infested, dead insects not removed) one seer	1% by weight of :	Apparent	Actual			
		Derris	88·6	63·0	647	134	Examined after 8 days' exposure
		Pyrethrum	91·4	71·9	666	20	
		Copper carbonate	99·7	97·2	689	19	
		Coal ash (Fine)	88·2	61·9	849	103	
		Raw paddy husk (Coarse)	82·7	51·2	877	20	
		Raw paddy husk (Fine)	57·2	..	605	6	
		Paddy husk ash (Coarse)	75·8	21·7	699	..	
		Paddy husk ash (Fine)	95·8	86·3	195	660	
		Wood ashes	78·4	30·9	791	26	
		Lime powder	84·2	49·2	485	139	
		Kaolin	71·1	5·0	842	29	
		(Control)	69·1	..	622	22	
		Note.—The actual percentage of mortality in raw paddy husk (Fine) is not shown as it has given a lower rate of mortality than the 'control'					

TABLE III

Rates of mortality of *Tribolium* sp., and *Rhizopertha dominica* under different treatments

Substance	*Tribolium* sp.			*Rhizopertha dominica*		
	Percentage of Mortality	No. of beetles		Percentage of Mortality	No. of beetles	
		Inside the bag	Outside the bag		Inside the bag	Outside the bag
1. Derris	100·0	2	9	69·2	49	16
2. Pyrethrum	88·8	7	2	84·6	24	2
3. Copper carbonate ..	84·6	69	9	45·0	11	9
4. Coal ash (Fine) ..				Not counted		
5. Raw paddy husk (Coarse)	..	2	..	14·3	21	..
6. Do. (Fine) ..	16·6	24	..	54·0	47	3
7. Paddy husk ash (Coarse)	68·4	19	..	81·0	95	..
8. Do. (Fine) ..	..	..	..	100·0	5	..
9. Wood ashes	100·0	2	..	38·0	21	..
10. Lime powder	73·6	17	2	38·0	35	7
11. Kaolin	67·6	32	2	40·7	32	22
12. Control	23·5	34	..	18·1	30	3

Our grateful thanks are due to Messrs. M. Appanna and N. Basaviah for their valuable assistance in setting up and evaluating the results of several experiments.

SUMMARY

1. The results of further experiments on the effect of certain inert and insecticidal substances mixed with grain on weevils (*Calendra oryzæ*) are described. The deterrent (and repellent) and insecticidal values of these materials as derived from short periods of exposure in insect-free and infested media are described.

2. Copper carbonate, coal ash (fine) and paddy husk ash (fine), the latter two of such fineness as to pass through a 100-mesh sieve, have very high insecticidal and deterrent effect. Dried leaves of vitex (ಲಕ್ಕಿ), neem and patchouli plants have no particular value in this direction.

3. *Tribolium* sp., and *Rhizopertha dominica* appear to be more tough and resistant than weevils but the comparative effect of the different substances used in these experiments on them was similar to that on weevils.

Volume Weight of Some Food Crops

Department of Agriculture in Mysore

Crop	Weight of 100 Mysore seers in lbs.
Ragi—	
K. 1	223
H. 22	227
Local Hullubele	229
Average weight	226
Paddy—	
S. 246	159
S. 199	165
S. 269	168
Alur and Nagpur Sanna	171
G.E.B. 24	178
S. 661, Kembuthi and Walya	181
Jola—	
Bili Jola	225
Mungar Bili Jola	218
Kaki Jola	212
Bajra	190
Navane	260
Avare—	
Bold	230
Small	240
Togari—	
Bold	235
Small	240
Horse-gram	230 to 235
Groundnut (pods in shell)—	
H.G. 1 and Coromandel	88
Spanish	98
Sesamum	200 to 205

Speech delivered by Rajamantra Pravina H. B. Gundappa Gowda, Esq., B.A., B.L., Minister for Local Self-Government and Public Health, at the 24th Annual General Meeting and Field-Day of the Mysore Agricultural and Experimental Union.

I learn with interest that the Association is twenty-four years old and that it was Dr. Coleman, the previous Director of Agriculture, who started the Association. Dr. Coleman evinced very great interest in the well-being of the Mysore farmer and correctly considered an organisation of this sort as a very desirable one specially in a country where 87 per cent. of the rural population are following the profession of Agriculture. The Association has for its primary object the bringing together of the officers of the Department of Agriculture and agriculturists all over the State and it is very essential that a bond of faith and friendship should develop between the farmers and the Departmental officers.

I understand that on previous occasions the Union used to hold its meetings over two or three days together. I see here three groups of interests, the officers of the Department, the agriculturists from different parts of the State and students of the Agricultural School, and inasmuch as the three interests belong to the one profession of agriculture, they may hold their meetings consecutively as at present arranged. It is conducive, I feel sure, to the growth of a healthy attitude about the profession. Regarding the officers themselves, I would say that it is desirable that they meet in a similar way as those engaged in the Medical or Engineering Services and use the meetings for a co-ordination of their different subjects and planning their work in a way that can be directly useful to the raiyats.

From the Report of the Union it is seen that there are about 500 members on its rolls. I must say at once that though the Association has attained its majority and is well on its way to celebrate its Silver Jubilee, this figure seems to indicate that the Association has not gathered sufficient strength or support commensurate with the time. I am aware that the membership includes free supply of a periodical and this ought to be sufficient inducement to a much larger number of agriculturists to join. Still the fact has to be faced that the membership of the Union is small. It is desirable that there should be a close touch between the Agricultural Department and the raiyats as is necessary for an advance in this line. The farmers should come to know that if they establish a contact with the Agricultural Department it will be advantageous to their industry. The Officers of the Department should try to induce more farmers to join the Union. The present number is somewhat less than a dozen members to a taluk. Those who subscribe to the *Agricultural Journal* should increase by thousands and the *Journal* should cater to the subscribers by giving them the required information in easy style and language. It is particularly necessary that orders of Government passed in the interests of the raiyats be

reproduced in the *Journal* so as to keep the agriculturists informed of such helpful orders and concessions afforded to them by the Government. Meetings like this should be organised and held regularly so that they might bring all the developments of the year to the notice of the raiyats and set them thinking.

With the onset of the war and the necessity to grow sufficient food, the attention of everybody has turned naturally more than ever to the problem of land and food production and the Agricultural Departments all over the world are looked up to for a solution of these difficulties. All over the world various plans of work like "Individual Farming", "Nationalised Farming" and "Co-operative Efforts" are under consideration. I must say that we have made a considerable advance here in Mysore in this direction and the Department of Agriculture has done good service to the raiyats with its accumulated knowledge of years. Government have at this juncture planned to help the raiyats in a number of ways such as supplying of good seed, manures, and iron materials for carts and implements at concession rates. It is hoped that the agriculturists will use this opportunity for improving their output of crops and for eliminating indebtedness and shoulder their part of the responsibility of solving the food problem.

Generally speaking, agriculture is not a profession of ease. All the same it is an honest profession which is ideal for a policy of 'live and let live'. It has its own problems. One should control his acquisitive inclinations. To have five acres and cultivate this land intensively is better than acquiring ten and cultivating it in a haphazard manner. There is such a quality as being agriculturally minded. The produce grown by the raiyat must be sold to his advantage. To this end a daily knowledge of prices is necessary. At present agriculture has got into the hands of poor and often ignorant people. As long as intelligent youths drift away from villages it is natural that the profession of agriculture should be placed at a disadvantage. Agriculture does not yield much money, but none can gainsay it does afford a decent living.

The Department of Agriculture is conducting demonstrations in the villages to prove the value of improved scientific farming. It is, however, desirable that educated raiyats should also come forward of their own accord and demonstrate these methods themselves. The number of such friends of the Agricultural Department should grow considerably. The Department on its part has the onerous duty of building a tradition in this regard.

Apart from the main objective of earning by cultivating the land the farmer should look to his cattle, poultry, sheep and goats, and try to earn a subsidiary income as well. An occasion for earning extra profit from agriculture had appeared in the last war also. But the raiyat then did not use his excess income through the hard times that ensued after the war. Depression and hard times are always ahead after a war. I hope the lessons of the last war will ensure necessary care and caution this time.

The meetings of the Union are proper occasions to exchange views and to formulate plans for future work. The attendance of the agriculturists at the meeting at present is poor. All the members should make it a point to be present and they should bring their friends with them. I wish the Union every success in its endeavour and may it become a source of strength both to the raiyats and the Department.

Report of the 24th Annual Meeting of the Mysore Agricultural and Experimental Union

The Twenty-fourth Annual General Meeting and Field-Day was held on 12th March 1944 at the Government Experimental Farm, Hebbal.

Members arrived at the Farm at 9-30 a.m., and went round the Experimental plots and Exhibition arranged for the occasion.

After meals the members sat down to business and elected members to the Managing Committee and Editorial Board.

Rajamantrapravina H. B. Gundappa Gowda, Esq., B.A., B.L., Minister for Local Self-Government and Public Health, was received on the Farm by the Officers of the Agricultural Department, students of Agricultural School and members of the Experimental Union, and he presided over the Assembly which began at 3 p.m.

Mr. M. J. Narasimhan, B.A., Director of Agriculture and President of the Union, welcomed the Minister. He traced the history of the Union and explained how the officers of the Department and the agriculturists were meeting on a common platform under its auspices.

The Secretary then read his Report giving the Audited Income and Expenditure Statement and the Balance Sheet as also the Budget for 1943-44, passed at the Managing Committee Meeting. The Report and Accounts were passed by the General Body and are given as an Appendix.

A few points for inclusion in the Constitution and Rules were proposed by Mr. S. L. Narasimhiah:—

(1) To be included as Para 6 in place of Associates, deleted: 'Life-Members—such of the members as pay a lumpsum of Rs. 100 will be taken as Life-Members of the Union.'—(*The Proposition was approved and passed by the General Body.*)

(2) In Para 6 under Affiliated Associations: Instead of 'a delegate of an Affiliated Association', to substitute 'a member of an Affiliated Association.'—(*The amendment was passed by the General Body.*)

(3) It was observed that Departmental Officers have repeatedly expressed that as they have been receiving only the English *Journals*, they have no opportunity to know the contents of the Kannada issue and the agricultural public with whom they come in contact in rural areas often try to discuss with them points which they have gathered from the Kannada *Journal*. With this in view, it was proposed to include the following clause under Subscription: 'Such of the Officers of the Agricultural Department as are members of the Union and are receiving the English *Journal* will be supplied the Kannada *Journal* also at an extra cost of Re. 1 per year.'—(*The proposal was accepted by the General Body after discussing the* pros. *and* cons.).

Mr. S. Srinivas moved the following resolutions, all of which were unanimously passed by the General Body:—

'*Resolved* that—

(1) The members assembled at the Twenty-fourth Annual Meeting of the Mysore Agricultural and Experimental Union do convey their gratitude to the Government of His Highness the Maharaja of Mysore, for the Annual Subvention graciously granted and request that in view of the work that the Union is doing in bridging the gulf between Departmental research and the

raiyat's field, the Annual grant may kindly be raised to Rs. 3,000 per annum for a period of at least five years.

(2) The members assembled at the Twenty-fourth Annual Meeting of the Mysore Agricultural and Experimental Union do express their gratitude to the Revenue Commissioner in Mysore for having recommended their Kannada *Journal* to the Village Panchayats year by year and in view of the negligible number of Panchayats now subscribing to the *Journal*, request that it may once again be recommended so that with the co-operation of the Revenue authorities in the Districts all the Panchayats be induced to subscribe to the *Journal*.

(3) The members assembled at the Twenty-fourth Annual Meeting of the Mysore Agricultural and Experimental Union do convey their gratitude to the Director of Public Instruction for having recommended the Kannada *Journal* of the Union to the rural Middle and Upper Primary Schools of the State and wish to represent the uniqueness of the *Journal* as one dealing with agriculture, the occupation of the majority of the rural population, and request that the *Journal* may be subscribed for by all the schools in the State.'

With the permission of the General Body the Secretary moved the following Resolution:—

'That the General Body of the Mysore Agricultural and Experimental Union feels that it is highly desirable to have a revised text-book of agriculture published and it requests the Director of Agriculture to take up the work as early as possible and arrange to bring out the publication.'—(*The Resolution was passed unanimously.*)

The results of the Elections were then announced after which the Constitution of the Managing Committee and the Editorial Board stood as follows:—

Managing Committee

President: Mr. M. J. Narasimhan, B.A., Director of Agriculture. *Vice-President*: Mr. S. Srinivas, Cleveland Town, Bangalore. *Members*: Messrs. Patel Hanumegowda, Marulenahally, Dodballapur; S. L. Narasimhiah, Devanahally; S. G. Rangaswamy, Colonist, Maddur; B. V. Venkatacharya, B.Sc.Ag., Alakere, Mandya; D. Veere Gowda, Malavalli; Venkatarama Sharma, Batchalli, Devanahally; V. N. Muniswamappa, Landlord, Devanahally; Syed Ibrahim, Anekal; Major C. B. Oakley, V.D., A.M.I.M.E., M.I.M., & M.E., Okleypuram, Bangalore. *Ex-officio Members*: The Deputy Director of Agriculture, Bangalore; The Superintendent of Civil Veterinary Services in Mysore, Bangalore. *Secretary*: Mr. M. Vasudeva Murthy, B.Ag.

Editorial Board

Chief Editor: Mr. K. H. Sreenivasan, B.A., M.Sc. (Edin.), Deputy Director of Agriculture, Bangalore. *Associated Editors*: Messrs. S. Venkatasubbiah, B.E., Agricultural Engineer; B. Krishnamurthy, B.Sc., Entomologist; Subedar Manikraj, G.B.V.C., Superintendent of Civil Veterinary Services; Dr. B. T. Narayanan, B.A., Ph.D., Agricultural Chemist; Dr. L. S. Dorasami, M.Sc., Ph.D., Economic Botanist; S. Srinivas, Landlord, Cleveland Town; B. V. Venkatacharya, B.Sc.Ag., Alakere, Mandya; S. V. Sharma, Senior Assistant Botanist, Paddy Section; K. M. Gururaja Rao, L.Ag., Principal, Agricultural School, Hebbal; C. V. Ramiah, Tobacco Superintendent, Bangalore. *Secretary and Editor, Kannada Journal*: M. Vasudeva Murthy, B.Ag.

Mr. S. A. Gangadhara Sastry, M.A., M.A. (Com.), etc., was elected as auditor for 1943–44.

Then the subjects the members had sent in for discussion were taken up. The position with reference to the points were explained by the Minister and the Director of Agriculture. The salient points are summarised below:—

Mr. Venkatarama Sharma, Bachalli—

Topic	Decision or Reply
1. Seed, oilcake and fertilizers should be sold at concession.	It is proposed to sell groundnut-cake at 50 per cent. concession.
2. Giving the above as loan to poorer raiyats and collecting the loan at the end of the year.	The Taccavi Loans and concession rates ought to be sufficient. It would be hard to discriminate in giving loans.
3. Wages should be controlled just as the prices of produce are controlled.	This is not a feasible proposition.
4. Giving premium prices to those who supply seed to the Department.	A 10 per cent. premium is being given at present and is fixed after much consideration.
5. Credit sale of implements and the realization of amount at harvests.	It is not advisable to encourage credit for all these small transactions.
6. Ration of foodstuffs at present fixed is not sufficient to agricultural workers. One and a half seers of ragi or one seer of ragi and half a seer of rice per day per individual may be proposed.	Rations at present fixed are settled after taking into consideration average condition and stocks. It has to be put up with as a hard-time policy.
7. Suppl of cloth at control prices to agriculturists.	Mr. Gowda Shivappa of Kalpanahally said that there was not enough supply of Standard Cloth at Davangere, and at any rate it had not reached the villages round about. It was resolved that the Government be requested to kindly equalise the distribution of cloth in these parts.
8. Wages should be paid in terms of ragi to coolies in the countryside; so enough ragi should be left with owners to pay the wages.	Mr. Hanumegowda of Marulenahally expressed that already there is a rule to leave 25 per cent. of ragi with the raiyats for this purpose. Other members were of opinion that it should be scrutinised if the rule is being worked to the advantage of the raiyat in all places.
9. Much land is left fallow for want of capital. That should be facilitated to be brought into cultivation.	Taccavi loans are being given now for development purposes. After all agriculturists should not entirely depend on loans to bring lands into cultivation, and better agriculture is conducted in having just enough land and cultivating it well.
10. Union Members should keep Farm Accounts so that they may be of use when costs are considered for any business purpose.	It was considered that this was a very good proposal but members should themselves come forward to keep accounts.
11. Arranging labourers where they are not at present available.	This was considered a very big problem, the solution for which would not be arrived at from this platform.

Major C. B. Oakley, Mesrs. T. Gopala Raj Urs, N. C. Viswanath, G. Basavalingiah, J. N. Puttanna, S. Venkataswamy Gowda and Puppe Gowda who had sent a few points were not present to put forward their subjects.

Mr. B. V. Venkatacharya, Inamdar, Alakere, Mandya—

Topic	Decision or Reply
1. Explained his self-sufficiency idea. He said that each district, taluk or even village unit, should have a survey of its resources and requirements and that each district is big enough to consider whether the required quantities of foodstuffs and oil-seeds are being grown within its borders. Depending always on imports would put the locality into difficulty and a planned cropping may carry it on smoothly.	It was considered that the self-sufficiency idea has come up on account of war conditions and as a general problem for all times, planning and cropping is more or less an all-India problem.

The Deputy Director of Agriculture just mentioned that there was such a consideration as Food Crops *vs.* Industrial Crops and this subject was taken up for further discussion.

Mr. K. Krishnaraju of Bhudevi Farm, Mysore, explained about Perennial Green Manuring Plants, *Gliricidia maculata* and *Sesbenia aegyptiaca*, and said he could supply seeds and seedlings. It was suggested that they may be examined by the Department for green manuring value.

B. Hutchegowda, Banasandra, Tumkur District—

Topic	Decision or Reply
1. Demonstration plots should be organized as part of the rural drive.	The Deputy Director explained that about 4,460 Demonstration plots, 229 Subvention plots and 2,343 'A' Farms were organised in 1942-43, and they were spread all over the State. Mr. Gowda Shivappa of Kalpanahally considered that it was necessary that the raiyats also should conduct trials of their own and these would be further demonstrations to the people around. Now that the rural development scheme was being extended to almost all the villages in the State, such demonstrations would naturally form part of that programme and every effort will be made to make these as widespread as possible.
2. Prices of chickens and eggs should be reduced by 50 per cent.	It was considered that the price would be a consideration if there was enough poultry to be distributed on a large scale in the first place. The Department should try to increase its saleable stock. It was also suggested that where price was considered high, eggs may be purchased and hatching arranged by the buyer.

The extra points raised by Mr. A. Ramaswamappa and K. K. Channappa were as follows:—

Topic	Decision or Reply
1. Making the Agricultural Department responsible for giving Development Loans.	This was not considered to be practical.
2. Increasing the quantity of manure given to each acre of paddy from one bag to three or four bags.	This would be done if found necessary.

After these discussions, the Chairman delivered his speech, printed elsewhere in the *Journal*.

The Vice-President, Mr. S. Srinivas thanked the President for having graced the occasion with his presence and all others who had helped to make the function successful.

The assembly terminated with three cheers to His Highness the Maharaja of Mysore.

SELECTIONS

All-India Food Production

Additional Three-Quarter Million Tons Expected

An additional yield of 714,214 tons of foodgrains is expected from the Grow More Food schemes for which financial assistance has been given to Provinces and States by the Government of India in the first three months of the current year. The schemes cover distribution at concession rates of improved seed and manure, carrying out of minor irrigation schemes and emergency irrigation projects, construction of embankments and reclamation of land. Grants amounting to Rs. 106 lakhs and loans to Rs. 116 lakhs have already been sanctioned.

An increase of 10 million acres of area under rice and millets and 3·5 million acres under wheat and gram over the acreage of the three pre-war years 1936–39 is aimed at in British India during 1944–45.

Production of foodgrains from reclaimed areas as a result of schemes sanctioned in the first quarter of 1944–45 will total 63,369 tons. The largest yield is expected from the distribution of improved seed which comes to 351,308 tons. Seed multiplication schemes will yield an additional amount of 25,056 tons, distribution of manure at concession rates 84,378 tons and minor irrigation schemes and emergency projects nearly two lakh tons.

In Bengal

In Bengal Rs. 8½ lakhs have been sanctioned for distribution of improved types of seeds and manure. Two thousand tons of oilcakes will be distributed for manuring potatoes and 100 tons of bonemeal for manuring rice. A loan of Rs. 23 lakhs has also been sanctioned for the purchase and distribution of seeds and manure. As a result of these schemes an additional production of 105,415 tons of foodgrains is expected during 1944–45.

In Madras Rs. 11 lakhs have been sanctioned for distribution of seeds and manure, reclamation of 40,000 acres of dry land, construction of 627 wells and for a scheme of seed multiplication. Further, a loan of Rs. 15 lakhs for reclamation of dry land and a loan of Rs. 45 lakhs for purchase and distribution of manures and improved seed have also been sanctioned. An additional yield of 137,137 tons is expected.

Grants amounting to Rs. 23 lakhs (Rs. 10 lakhs from Central Revenues and Rs. 13 lakhs from the Cotton Fund) have been sanctioned for Bombay to finance schemes of distribution of improved seeds and manure, including 500 tons of bonemeal and 50,000 tons of groundnut cake, and construction of new tanks and wells. A loan of Rs. 8 lakhs has been given for construction of wells and repairs to tanks. The additional yield expected is 70,524 tons.

Composting Town Refuse

Similar grants and loans for distribution of improved seeds and manure have been sanctioned for other provinces. Other special grants are Rs. 178,000 for special minor irrigation works in Bihar, Rs. 6½ lakhs for emergency irrigation projects in North-West Frontier Province and Rs. 17 lakhs in the Punjab for sinking of 5,000 surface percolation wells, manufacture of compost from

waste vegetable material, extension of crop for green manuring, use of oilcake as manure and extension of cultivation by clearing riverain areas. In Baroda grants amounting to Rs. 7 lakhs have been sanctioned from the Cotton Fund for various schemes relating to the diversion of area from cotton crop to food crops.

The Imperial Council of Agricultural Research has sanctioned Rs. 2,72,000 for schemes relating to the composting of town refuse into manure and multiplication of disease-free seed potato and an enquiry for the improvement of yield statistics of agricultural crops and crop cutting experiments in the United Provinces and the Punjab.

—*The Bengal Weekly*, Calcutta July, 17, 1944.

Farm Tenancy in Minnesota

Tenancy is a process whereby a young man acquires the capital and experience needed before he can safely assume ownership.

Thirty-four per cent. of the farm-operators in Minnesota were tenants and 47 per cent of all farm land in the state was tenant-operated in 1935. Tenancy has been increasing steadily ever since it was first reported in the Federal Census in 1880.

The average size of the tenant-operated farms in Minnesota in 1935 was 180 acres as compared with 128 acres for owner-operated farms and 222 acres for part-owner farms. The average value per acre of the tenant farms was $ 40·00 as compared with $ 47·00 for owner-operated farms, and $ 36·00 for part-owner farms.

Twenty-one per cent. of the rented land in Minnesota in 1936 was owned by corporations (largely lending agencies); 46·3 per cent. by farmers, widows of farmers, and local estates; 10·9 per cent. by local nonfarmers; and 21·3 per cent. by non-resident individuals and estates (outside of country). Practically all of the land owned by the corporate owners is held for sale. Sixty per cent. of the farmers and farmers' wives and 74 per cent. of the non-farm landlords reported their land for sale.

The average age of the tenants covered in the study was 41 years. This is less than that of owner-operators but greater than that of tenants reported in the Federal Census in earlier years. Apparently as large a proportion of tenants achieve ownership as formerly but at a more advanced age.

The 1930 Federal Census reports that 31·5 per cent. of the farm tenants in Minnesota were related to their landlords. Thirty per cent. of the tenants reporting in this study were related and of these 60 per cent. were sons and 14 per cent. sons-in-law of their landlord.

The average number of years that these tenants had been farming was 11. Related tenants and tenants on small farms were somewhat younger than other tenants.

The principal types of farm leases in Minnesota and the proportion of farms studied using each are: cropshare cash, 44 per cent.; cash 30 per cent.; livestock-share, 14 per cent ; and crop-share, 12 per cent. Cash leases are used more largely on small farms, on livestock farms, and on highly specialized farms. Share leases predominate on the larger farms and where the crops grown are easily divided and saleable.

The common shares of the grain crop given as rent and the proportion of farms reporting each share is: one-foruth, 4 per cent.; one-third, 41 per cent.; two-fifths, 13 per cent.; and one-half, 42 per cent. One-half of the hay crop is the most common share with one-third next in frequency. The two-fifths share rent is confined largely to southern and especially south-western Minnesota and the one-fourth largely to the north-western part.

Cash rental rates per acre in 1936 varied from $ 4·60 in south-western Minnesota to $ 92 in north-eastern. Cash rentals in any area were fairly closely related to crop yields and percentage of tillable land in that area.

Under crop-share cash leases the rental rate per acre was higher for plow land than for wild hay and pasture. Fifty per cent. of the institutional landlords and 10 per cent. of the others charged cash rent for the farmstead and buildings, and the average amount charged per farm was $ 25·00.

Under cash leases and crop-share leases other than one-half share crop leases the landlord does not usually make any contribution to operating costs, but under the crop-share cash and the one-half share crop lease the landlord commonly pays all or part of the seed, twine, or threshing costs. Under the livestock-share lease the landlord pays a share of all operating expenses other than labor, usually one-half.

Tenants were accorded the right to determine the cropping system by 55 per cent. of the lease contracts in which crop determination was mentioned, and landlords, by 21 per cent. of the leases. Determination was made jointly according to the remaining 24 per cent.

Seven per cent. of the leases included a provision for adjusting rental rates in case of market price changes, and 8 per cent. included a provision for adjustment in case of crop failure.

Nearly one-half of the leases permitted tenant to remove at the expiration of the lease any fences erected by him at his own expense.

Eighteen per cent. of the leases provided for the remuneration of the tenant for inexhausted improvements. The principal improvements specified were fall plowing, summer fallow, and the seeding of legumes and grasses.

Seventy per cent. of the leases studied were in writing. Institutional landlords used written leases almost exclusively, nonresident owners somewhat less, and farmers least of all.

About two-thirds of the leases studied became effective in the spring and one-third became effective in the fall. March 1, and October 1, were the common dates these leases were effective.

Twenty-five per cent. of the March 1 leases were made six months or more in advance and 19 per cent. from three to five months in advance. Only 13 per cent. of the October 1 leases were made as much as six months in advance and 6 per cent three to five months in advance.

Eighty-two per cent. of all leases were for one year, 4 per cent. for two years, 9 per cent. for three years, 1 per cent. for four years and 4 per cent. for five years.

Nineteen per cent. of the leases contained a renewal clause with 4·8 months as the average time that notice of withdrawal must precede the termination of the lease. Advance notices were longer in case of March 1 leases than in case of fall leases.

Thirty-six per cent. of all leases contained a cancellation clause permitting the landlord to cancel the lease in case of sale or of breach of contract by the tenant. The average occupancy of their present farms by tenants is 4·6 years and 40 per cent. have been on the same farm more than five years.

More than 50 per cent. of the tenants who move do so on their own volition rather than at the request of their landlord.

Nineteen per cent. of the crop land is in soil building crops on owner-operated farms and 17 per cent. on tenant-operated farms.

Thirty-five per cent. of the landlords reported that crop yields were lower than when they first acquired their farms, 40 per cent. reported them the same, and 25 per cent. reported higher yields. Tenants for their period of occupancy reported lower yields in 7 per cent. of the cases, the same in 42 per cent. and higher in 51 per cent.

Eight per cent. of the tenants report that weed infestation had increased during their occupancy, 11 per cent. report no change, and 81 per cent. report a decrease.

A comparison of farm earnings and success factors for owner-operators and tenant-operators taken from farm accounting records indicates that the former have higher crop yields, a better selection of crops, and more livestock per 100 acres, whereas the tenant-operators have larger farms, higher dairy production, greater efficiency in the use of feed and labour, and higher earnings (measured in terms of operator's labour earnings on a full ownership basis).

Home conveniences such as running water, electricity, and bath tubs were not encountered in this study in as large a proportion of the tenant homes as was reported by the Federal Census for all farms in the same counties.

The proportion of tenants' children from 10 to 20 years of age enrolled in 4-H club work is greater than for all rural children of that age in the state.

Tenants criticize our present tenancy system largely because it limits their choice of crops and their fecilities for livestock production.

More tenants report receiving managerial assistance from their landlords or their agent than report difficulty with them due to their lack of agricultural knowledge and experience.

The principal criticisms by tenants of their present leases deal with security of tenure and equitability.

A larger proportion of landlords than of tenants was satisfied with their present leases and with tenancy conditions. The landlords' criticisms chiefly concerned the quality of tenants and the equitability of leases.

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